



Evaluation of a mobile mindfulness app distributed through on-line stores: A 4-week study[☆]



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ABSTRACT

Recently, interactive approaches aimed at helping people practice mindfulness have appeared in the literature. However, the few available user studies for such approaches focus only on short-term effects and are carried out in a lab or in a similar artificial setting. In this study, we aim instead at assessing the effectiveness of a mobile mindfulness app when used by people in their everyday contexts and over a prolonged period of time. People could participate in the study by downloading the app from Apple's App Store as well as Google Play and by answering a mindfulness questionnaire at three pre-set times over a 4-week period. Moreover, the app automatically collected usage data each time it was used and qualitative feedback at the end of the study. Results reveal that users with no or minimal experience with meditation significantly increased their level of mindfulness over the 4-week study period. Moreover, the qualitative feedback provided by participants indicates that the app was positively perceived as beautiful and its usage elicited positive feelings in most of them. We discuss possible factors that could have contributed to the obtained results. Finally, we analyze how many users abandoned the study and at what times, comparing such data with other studies based on app stores distribution, and giving possible reasons.

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1. Introduction

Mindfulness has been described as the awareness that arises through “paying attention to the present moment on purpose and nonjudgmentally” (Kabat-Zinn, 1990). A fundamental component of mindfulness, called *decentering*, is “the ability to observe one's thoughts and feelings as temporary, objective events in the mind, as opposed to reflections of the self that are necessarily true” (Safran and Segal, 1996) and “a state of awareness of internal events, without responding to them with sustained evaluation, attempts to control or suppress them, or respond to them behaviorally” (Wells, 2005). Decentering is considered particularly important in the literature because it can be helpful in reducing negative emotional states, such as anxiety, worry and ruminative thinking, by helping individuals realize that their thoughts are impermanent events in the mind, see e.g. Hoge et al. (2015) and Querstret and Cropley (2013). Typically, decentering is achieved by practicing techniques that require individuals to be aware of their thoughts and to observe them while they pass by,

without acting or grasping on them, and without trying to suppress them (hereinafter, we refer to this kind of practice¹ as *distancing from thoughts*).

Unfortunately, distancing from thoughts, as any other mindfulness practice can be difficult for people with no or minimal experience with meditation (in the following, *naive² meditators*) (Kabat-Zinn, 2005; Segal et al., 2002). This fact has captured the attention of the HCI community that has started proposing new, computer-based interactive approaches to help people practice mindfulness, e.g. Thieme et al. (2013) and Vidyarthi et al. (2012). In Chittaro and Vianello (2014), we proposed a smartphone app, called AEON, specifically aimed at helping people practice distancing from thoughts, and we evaluated it with a lab experiment. The study contrasted the app with two traditional techniques for distancing from thoughts that are not based on technology. AEON

¹ We use the term “practice” to refer to the act of performing meditation exercises, consistently with studies of mindfulness interventions, see e.g. Chiesa and Malinowski (2011) and Keng et al. (2011) for reviews.

² While we are aware that the term “novice” is used in HCI to indicate users that are new to a task, in this paper we use the term “naive” to refer to people with no or minimal experience with meditation, consistently with meditation studies, see e.g. Moore and Malinowski (2009), Soler et al. (2014) and Thompson and Waltz (2007).

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obtained better results in terms of achieved level of decentering, perceived level of difficulty and degree of pleasantness.

However, although the evaluation showed that AEON can help people in achieving decentering, it was carried out within a lab setting and it measured only short-term effects. These limitations are typical threats to the external validity of a study and are common to all studies of computer-based mindfulness proposed in the literature so far. A lab, or a similar artificial setting, does not reflect the many different contexts and situations in which a mindfulness application can be used by people in their everyday life. In general, although such settings allow researchers to control for unsystematic variables and thus increase the internal validity of a study, the obtained results cannot be easily generalized to other contexts, and there is a need to conduct studies that can include the real-world contexts of use (Henze and Pielot, 2013; Henze et al., 2013).

For these reasons, we carried out a 4-week study aimed at assessing the effectiveness of the AEON app when used over a prolonged period of time in the users' everyday contexts.

The paper is organized as follows: Section 2 briefly reviews recent research on computer-supported mindfulness techniques and introduces the “research in the large” approach to evaluation. Section 3 presents the method for the current study, whose findings are illustrated in Section 4 and discussed in Section 5. Finally, Section 6 draws conclusions and outlines future work.

2. Related work

2.1. Computer-supported mindfulness

Mindfulness techniques were historically associated to Eastern meditation practices that have their roots in Buddhist teachings (Gunaratana, 2002). From the 1970s, independently of any specific circumscribed philosophy or system of practices, such techniques began to be included in manualized interventions for treating a variety of psychological and physical problems in clinical and non-clinical populations (Chiesa and Malinowski, 2011; Keng et al., 2011). The first intervention of this kind was the Mindfulness-Based Stress Reduction program (MBSR) (Kabat-Zinn, 1990), i.e. a 8- to 10-week program in which a group of up to 30 participants meets weekly for 2–2.5 h sessions together with an all-day (7–8 h) intensive session usually held around the sixth week. MBSR includes several exercises to help practitioners cultivate mindfulness, such as distancing from thoughts (see Introduction section) and *mindful breathing*, i.e. a practice that requires practitioners to direct their attention to the sensations of breathing and to be aware of it in each moment. When practitioners note that the mind has wandered away, they simply have to observe non-judgmentally what has happened and to bring the attention back to breathing (Baer, 2003). For a more detailed description of MBSR and other mindfulness-based interventions, see (Chittaro and Vianello, 2014).

Recently, the HCI community has started proposing computer-based approaches aimed at supporting people in mindfulness practices. In the following, we focus on the approaches that turn mindfulness exercises into novel experiences in which the user interacts with the computer application during the practice (*interactive practices*, in the following).

The Meditation Chamber (Shaw et al., 2007) and Sonic Cradle (Vidyarathi et al., 2012) propose interactive practices for mindful breathing. They both consist of immersive installations in which users can interact via their respiration (and also via other physiological parameters in the case of the Meditation Chamber) to control visual or audio content respectively. In this way, they offer users a tangible target to focus their attention on and invite its re-

direction if it has drifted away. The Meditation Chamber, which comprises also muscle relaxation techniques, was shown to be effective at promoting relaxation, see (Shaw et al., 2007), while the qualitative study described in Vidyarathi and Riecke (2014) revealed that by using Sonic Cradle participants experienced some subjective elements typical of mindfulness meditation, such as reduced thought and clarity of mind. Moreover, participants described their experience with Sonic Cradle as relaxing and desirable, while experienced meditators suggested it was easier to engage with Sonic Cradle compared to their prior experiences with meditation.

The Mindfulness Sphere (Thieme et al., 2013) relies on heart-beat rather than breathing perception as an object of user's attention. The system is specifically aimed at introducing mindfulness in an intervention targeting women with a dual diagnosis of Learning Disability and Borderline Personality Disorder. It consists of a 12-cm diameter sphere that can sense the heartbeat of the user who touches it and translates it into visual and tactile feedback through multicolor LEDs or soft vibrations. However, this interactive practice was not formally evaluated and thus its effectiveness in promoting mindfulness remains unknown.

Finally, Yu et al. (2012) proposed two systems to support users in practicing *walking meditation*, i.e. a mindfulness practice that focuses attention on breathing combined with walking. More specifically, the technique requires users to slowly walk by lifting the foot with heel first while breathing in, and land the foot with toes first while breathing out. The first system (Walking-Aware System, WAS) aims at enhancing users' awareness of walking and consists of a pair of shoes equipped with three force sensors, while the second system (Breathwalk-Aware System, BAS) aims at fully supporting walking meditation by introducing also respiratory sensors. For both systems, the interactive practice is supported by a mobile app that provides walking (WAS and BAS) and breathing (BAS) guidance and feedback. Results of two studies (Yu et al., 2012) showed the effectiveness of WAS and BAS in increasing user's awareness of walking and support the practice of walking meditation, respectively.

Unfortunately, all the computer-based mindfulness approaches surveyed above require special hardware and settings that are scarcely accessible to the general public.

For this reason, we opted instead for smartphone platforms to increase the opportunities and the contexts in which users can practice, as our mobile app can run without additional equipment on common smartphones that follow users everywhere. The app, called AEON, aims at helping users practice distancing from thoughts and was first proposed in a previous paper (Chittaro and Vianello, 2014) that included a lab study. To the best of our knowledge, that study was the first to formally evaluate a mobile mindfulness app, while none of the mindfulness apps available on online stores, such as Apple's App Store or Google Play, has undergone such scientific scrutiny, as remarked in a recent review of mindfulness apps (Plaza et al., 2013).

AEON allows users to enter their thoughts into the smartphone and then visualizes them as written in ink on a parchment under water. Users can interact with the water by moving their finger anywhere on the screen. In this way, they produce dynamic waves that progressively dissolve the written thought. The water simulation aims at offering users a tangible visualization for a mindfulness exercise that does not rely on physical sensations as mindful breathing or walking meditation do. Moreover, it aims at evoking in users the sensation that each thought is impermanent.

To evaluate the effectiveness of the app in helping users achieve decentering, in Chittaro and Vianello (2014) we contrasted the practice of distancing from thoughts with AEON and with two traditional techniques that are not based on technology. Results revealed that AEON was able to produce a better level of

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